

AMERICAN WOODCOCK HARVEST AND BREEDING POPULATION STATUS, 1999

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Abstract: Wing-collection and Singing-ground surveys were conducted to assess the population status of the American woodcock (*Scolopax minor*). The 1998 recruitment index for the Eastern Region (1.7 immatures per adult female) equaled the long-term regional average; the recruitment index for the Central Region (1.6 immatures per adult female) was 6% below the long-term regional average. The index of daily hunting success in the Eastern Region increased from 1.8 woodcock per successful hunt in 1997 to 1.9 woodcock per successful hunt in 1998, but seasonal hunting success declined 4%, from 6.9 to 6.6 woodcock per successful hunter in 1997 and 1998, respectively. In the Central Region, the daily success index in 1998 was unchanged from the 1997 index (2.1 woodcock per successful hunt) but the seasonal success index increased from 10.0 to 11.0 (10%) woodcock per successful hunter. Singing-ground Survey data indicated that the number of displaying woodcock in the Eastern Region was unchanged ($P>0.1$) from 1998 levels. In the Central Region, there was a 13.4% decrease in the number of woodcock heard displaying ($P<0.01$) compared to 1998 levels. Trends from the Singing-ground Survey during 1989-99 were negative (-3.3 and -3.7% per year for the Eastern and Central regions, respectively; $P<0.01$). There were long-term (1968-99) declines ($P<0.01$) of 2.4% per year in the Eastern Region and 1.6% per year in the Central Region.

The American woodcock is a popular game bird throughout eastern North America that provides an estimated 3.4 million days of recreational hunting annually (U. S. Department of Interior 1988). The management objective of the U. S. Fish and Wildlife Service (FWS) is to increase populations of woodcock to levels consistent with the demands of consumptive and non-consumptive users (U. S. Fish and Wildlife Service 1990).

Reliable annual population estimates, harvest estimates and information on recruitment and distribution are essential for comprehensive woodcock management. Unfortunately, this information is difficult and often impractical to obtain. Woodcock are difficult to find and count because of their cryptic coloration, small size, and preference for areas with dense vegetation. Also, although a sampling frame for woodcock hunters is currently being developed as part of the Harvest Information Program, no comprehensive sampling

The primary purpose of this report is to facilitate the prompt distribution of timely information. Results are preliminary and may change with the inclusion of additional data.

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frame for woodcock hunters is currently available.

Because of these difficulties, the Wing-collection Survey and the Singing-ground Survey were developed to provide indices of recruitment, hunting success and changes in abundance.

This report summarizes the results of these surveys and presents an assessment of the population status of woodcock as of June 1999. The report is intended to assist managers in regulating the sport harvest of woodcock and to draw attention to areas where management actions are needed.

METHODS

Woodcock Management Units

Woodcock are managed on the basis of 2 regions or populations, Eastern and Central, as recommended by Owen et al. (1977) (Fig. 1). Coon et al. (1977) reviewed the concept of management units for woodcock and recommended the current configuration over several alternatives. This configuration was biologically justified because analysis of band recovery data indicated that there was little crossover between the regions (Krohn et al. 1974, Martin et al. 1969). Furthermore, the regional boundaries conform to the boundary between the Atlantic and Mississippi flyways. The results of the

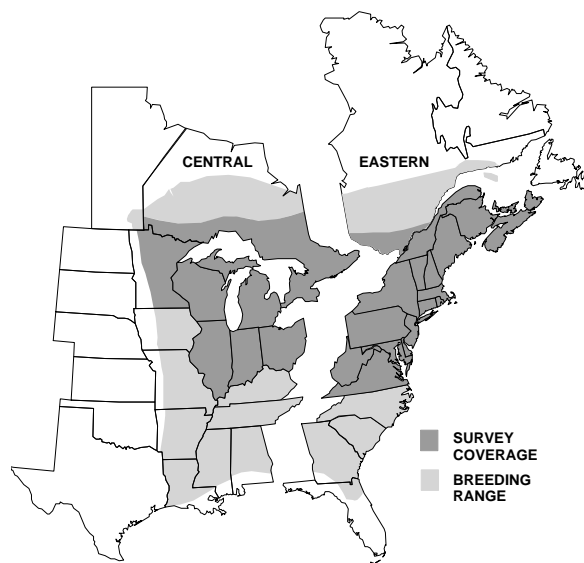


Fig. 1. Woodcock management regions, breeding range, and Singing-ground Survey coverage.

Wing-collection and Singing-ground surveys are reported by state or province, and region.

Wing-collection Survey

The Wing-collection Survey was incorporated into a national webless migratory game bird wing-collection survey in 1997. Only data on woodcock will be presented in this report. As with the old survey, the primary objective of the Wing-collection Survey is to provide data on the reproductive success of woodcock. The survey also produces information on the chronology and distribution of the harvest and data on hunting success. The survey is administered as a cooperative effort between woodcock hunters, the FWS and state wildlife agencies. Participants in the 1998 survey included hunters who either: (1) participated in the 1997 survey; or (2) indicated on the 1997-98 Annual Questionnaire Survey of U. S. Waterfowl Hunters or Harvest Information Program Survey that they hunted woodcock. Wing-collection Survey participants were provided with prepaid mailing envelopes and asked to submit one wing from each woodcock they bagged. Hunters were asked to record the date of the hunt, and the state and county where the bird was shot. Hunters were not asked to submit envelopes for unsuccessful hunts. The age and sex of the birds were determined by examining plumage characteristics (Martin 1964, Sepik 1994) during the annual Woodcock Wingbee, a cooperative work session. Wings were accepted through 22 April 1999.

The ratio of immature birds per adult female in the harvest provided an index to recruitment of

young into the population. The 1998 recruitment indices were compared to long-term (1963-97) averages. Annual indices were calculated as the average number of immatures per adult female in each state, weighted by the relative contribution of each state to the total number of wings received during 1963-97 (to maintain comparability between years).

Daily and seasonal bags of hunters who participated in the Wing-collection Survey in both 1997 and 1998 were used as indices of hunter success. These indices were weighted to compensate for changes in the proportion of the estimated woodcock harvest attributed to each state and adjusted to a base-year value (1969) for comparison with previous years (Clark 1970, 1972, 1973). Only data on successful hunts from prior years were used so that they would be comparable to data from the new survey. A successful hunt was defined as any envelope returned with complete information in which ≥ 1 woodcock wing was received.

Singing-ground Survey

The Singing-ground Survey was developed to exploit the conspicuous courtship display of the male woodcock. Early studies demonstrated that counts of singing males provide indices to woodcock populations and could be used to monitor annual changes (Mendall and Aldous 1943, Goudy 1960, Duke 1966, and Whitcomb 1974). Before 1968, counts were conducted on non-randomly-located routes. Beginning in 1968, routes were relocated along lightly traveled secondary roads in the center of randomly chosen 10-minute blocks within each state and province in the central and northern portions of the woodcock's breeding range (Fig. 1). Data collected prior to 1968 are not included in this report.

Each route was 3.6 miles (5.4 km) long and consisted of 10 listening points. The routes were surveyed shortly after sunset by an observer who drove to each of the 10 stops and recorded the number of woodcock heard peenting (the vocalization by displaying male woodcock on the ground). Acceptable dates for conducting the survey were assigned by latitude to coincide with peaks in courtship behavior of local woodcock. In most states, the peak of courtship activity (including local woodcock and woodcock still migrating) occurred earlier in the spring and local reproduction may have already been underway when the survey was conducted. However, it was necessary to conduct the

survey during the designated survey dates in order to avoid counting migrating woodcock. Because adverse weather conditions may affect courtship behavior or the ability of observers to hear woodcock, surveys were only conducted when wind, precipitation, and temperature conditions were acceptable.

The survey consists of about 1,500 routes. In order to avoid expending unnecessary manpower and funds, approximately one half of these routes are surveyed each year. The remaining routes are carried as "constant zeros." Routes for which no woodcock are heard for 2 consecutive years enter this constant zero status and are not run for the next 5 years. If woodcock are heard on a constant zero route when it is next run, the route reverts to normal status and is run again each year. Data from constant zero routes are included in the analysis only for the years they were actually surveyed. Sauer and Bortner (1991) reviewed the implementation and analysis of the Singing-ground Survey in more detail.

Trend Estimation.—Trends were estimated for each route by solving a set of estimating equations (Link and Sauer 1994). Observer data were used as covariables to adjust for differences in observers' ability to hear woodcock. To estimate state and regional trends, a weighted average from individual routes was calculated for each area of interest as described by Geissler (1984). Regional estimates were weighted by state and provincial land areas. Variances associated with the state, provincial, and regional slope estimates were estimated using a bootstrap procedure (Efron 1982). Trend estimates were expressed as percent change per year and trend significance was assessed using normal-based confidence intervals. Short-term (1998-99), intermediate-term (1989-99) and long-term (1968-99) trends were evaluated.

The reported sample sizes are the number of routes on which trend estimates are based. These numbers may be less than the actual number of routes surveyed for several reasons. The estimating equations approach requires at least 2 non-zero counts by the same observer for a route to be used. With the exception of the 1998-99 analysis, routes that did not meet this requirement during the interval of interest were not included in the sample size. For the 1998-99 analysis, a constant of 0.1 was added to counts of low-abundance routes to allow their use in the analysis. Each route should be surveyed during the peak time of singing activity. For editing purposes, "acceptable" times were between 22 and 58 minutes after sunset (or, between

15 and 51 minutes after sunset on overcast evenings). Due to observer error, some stops on some routes were surveyed before or after the peak times of singing activity. Earlier analysis revealed that routes with 8 or fewer acceptable stops tended to be biased low. Therefore, only route observations with at least 9 acceptable stops were included in the analysis. Routes for which data were received after 1 June 1998 were not included in this analysis but will be included in future trend estimates.

Annual indices.—Annual indices were calculated for the 2 regions and each state and province by finding the deviation between the observed count on each route and that predicted by the 1968-99 regional or state/provincial trend estimate. These residuals were averaged by year and added to the fitted trend to produce annual indices of abundance for each region, state and province. Yearly variation in woodcock abundance was superimposed on the long-term fitted trends (see Sauer and Geissler 1990). Thus, the indices calculated with this method portray year-to-year variation around the predicted trend line, which can be useful for exploratory data analysis (e.g., observing periods of departure from the long-term trend). However, the indices should be viewed in a descriptive context. They are not used to assess statistical significance and a change in the indices over a subset of years does not necessarily represent a significant change. Observed patterns must be verified using trend estimation methods to examine the period of interest (Sauer and Geissler 1990, Link and Sauer 1994).

RESULTS

Wing-collection Survey

A total of 3,751 potential woodcock hunters in states with woodcock seasons were contacted and asked to participate in the 1998 Wing-collection Survey. Twenty-five percent (Table 1) cooperated by sending in 7,578 woodcock wings (Table 2). Due to clerical error, many hunters in Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, and Vermont did not receive their envelopes in time to provide wings.

Recruitment.—The 1998 recruitment index in the Eastern Region (1.7 immatures per adult female) equaled the long term (1963-97) regional average (Table 2, Fig 2). In the Central Region the 1998 recruitment index (1.6 immatures per adult female) was 6% below the long-term regional average of 1.7 immatures per adult female.

Hunting Success.—The index of daily hunting success in the Eastern Region was 1.9 woodcock per successful hunt, slightly higher than during the 1997 season (1.8 woodcock per successful hunt) (Table 3). The index of seasonal hunting success decreased 4%,

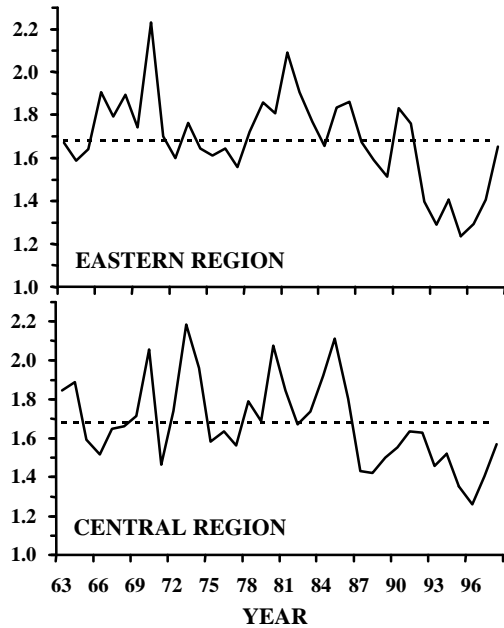


Fig. 2. Adjusted annual indices of recruitment, 1963-98. The dashed line is the 1963-97 average.

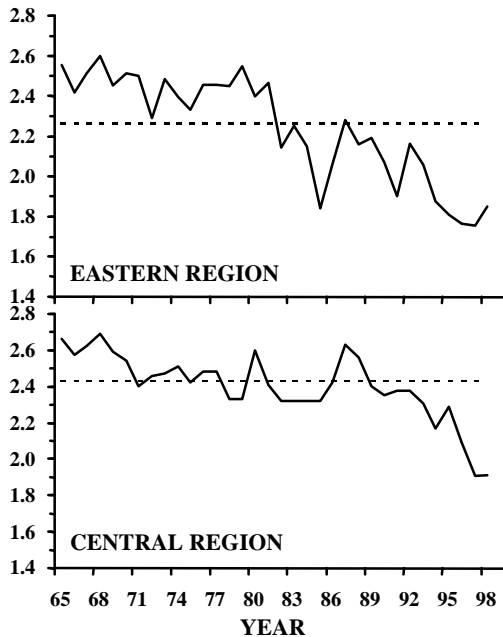


Fig. 3. Base-year adjusted indices of daily hunting success, 1965-98. The base year is 1969; the dashed line is the 1965-97 average.

from 6.9 to 6.6 woodcock per successful hunter. In the Central Region, the daily success index (2.1 woodcock per successful hunt) was unchanged from the 1997 index; the seasonal success index increased 10%, from 10.0 woodcock per successful hunter in 1997 to 11.0 woodcock per hunter in 1998. Base-year adjusted indices of daily and seasonal hunting success were below long-term averages in both regions (Figs. 3 and 4).

Singing-ground Survey

Trend Estimation.—No changes ($P>0.1$) from 1998 levels were detected in the number of woodcock displaying during the 1999 Singing-ground Survey in the Eastern Region (Table 4, Fig. 5). The number of woodcock displaying in the Central Region decreased ($P<0.01$) 13.4% over 1998 levels. Trends for all states and provinces are reported in Table 4 but results based on fewer than 10 routes should be considered unreliable.

Trends for the 1989-99 period were computed for 356 routes in the Eastern Region and 444 routes in the Central Region. Eastern and Central region breeding populations declined ($P<0.01$) 3.3 and 3.7% per year, respectively, during this period (Table 4).

Long-term (1968-99) trends were estimated for 600 routes in the Eastern Region and 599 routes in

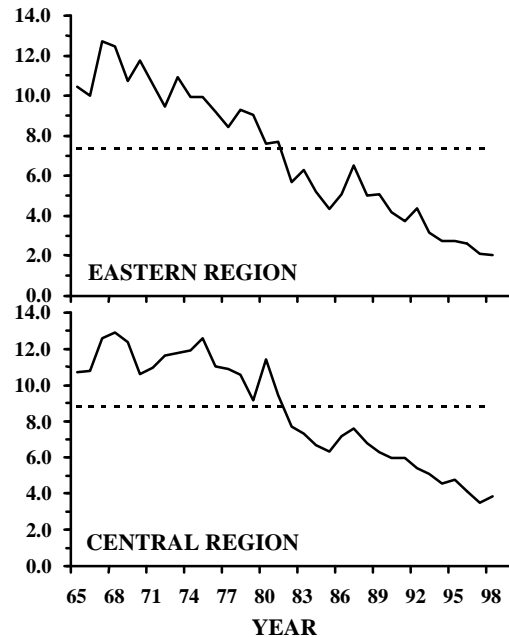


Fig. 4. Base-year adjusted indices of seasonal hunting success, 1965-98. The base year is 1969; the dashed line is the 1965-97 average.

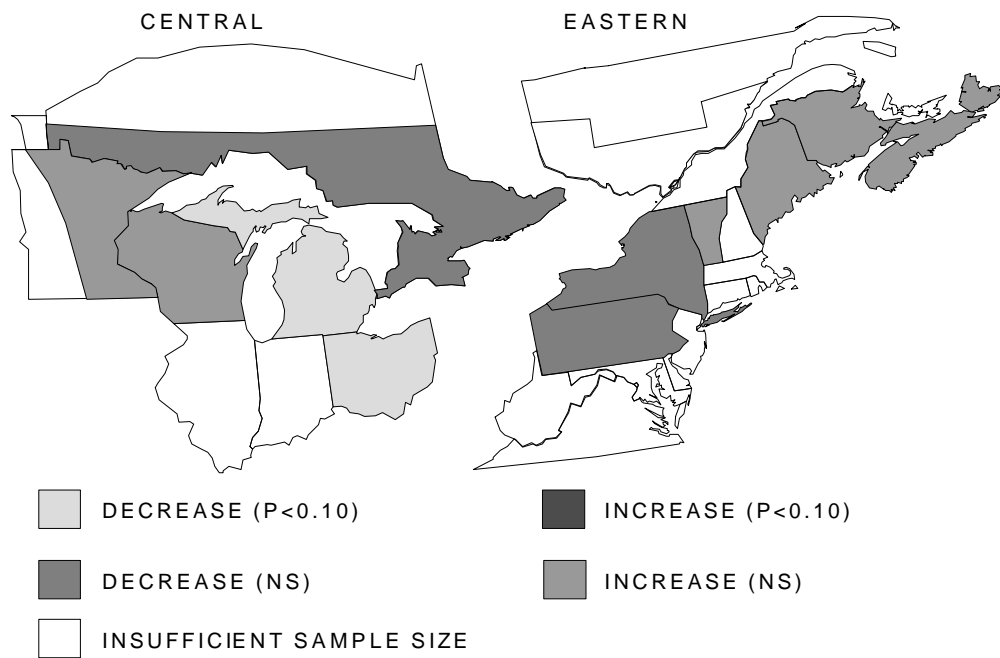


Fig. 5. Short-term trends in the number of American woodcock heard on the Singing-ground Survey, 1998-99.

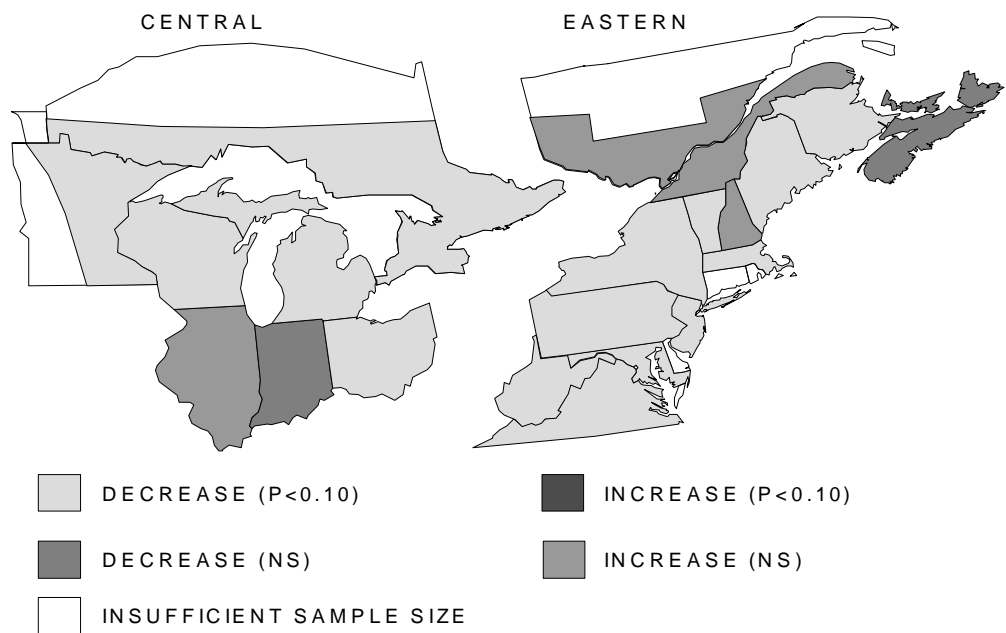


Fig. 6. Long-term trends in the number of American woodcock heard on the Singing-ground Survey, 1968-99.

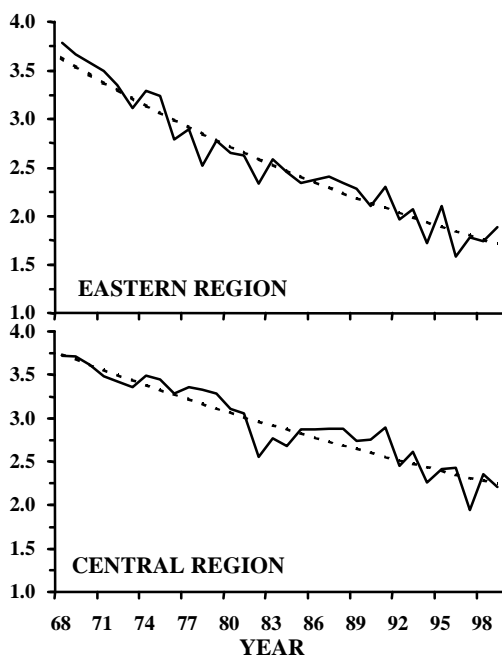


Fig. 7. Long-term trends and annual indices of the number of woodcock heard on the Singing-ground Survey, 1968-99.

the Central Region. There were long-term declines ($P < 0.10$) in the breeding population throughout most states and provinces in the Eastern and Central

Regions (Table 4, Fig. 6). The long-term trend estimates were -2.4 and -1.6% per year ($P < 0.01$) for the Eastern and Central regions, respectively.

Annual Breeding Population Indices.—In the Eastern Region, the 1999 breeding population index of 1.89 singing-males per route was greater than the predicted value of 1.72 (Table 5, Fig. 7). The Central Region population index of 2.21 males per route was very near the predicted value of 2.25.

DISCUSSION

Wing-collection Survey

Recruitment indices in both regions were higher in 1998 than in 1997. The recruitment index in the Eastern Region was the largest observed since 1991 and was equal to the long-term regional average. Although the recruitment index in the Central Region also was higher than it has been in recent years, it remained below the long-term regional average.

There were no changes in Federal frameworks for woodcock hunting in 1998. Daily hunting success increased slightly over the 1997-98 season in the

Eastern Region but was unchanged in the Central Region. Seasonal hunting success decreased slightly in the Eastern Region but increased in the Central Region during the 1998-99 season.

Seasonal hunting success indices from the Wing-collection Survey indicated that the annual woodcock harvest has been declining among participants in the survey for over a decade. This is consistent with the results of the Annual Questionnaire Survey of U. S. Waterfowl Hunters (Martin 1979, and unpubl. rep., U. S. Fish and Wildl. Serv., Office of Migratory Bird Management, Laurel, Maryland) which indicate that the woodcock harvest and the number of woodcock hunters have generally declined since the early 1980s (Fig. 8).

These results should be interpreted cautiously because of the limitations of both of these surveys. A comprehensive critique of these limitations is beyond the scope of this report; interested readers should see Owen et al. (1977), Martin (1979), and Straw et al. (1994). Briefly, indices based on the Wing-collection Survey are potentially biased because of the non-random sampling procedure by which survey participants were selected. Because the Annual Questionnaire Survey of U. S. Waterfowl Hunters does not provide information on the woodcock harvest by non-waterfowl hunters, it does not provide an estimate of total harvest or the total number of hunters. Nevertheless, results from this survey should at least approximate trends in harvest and hunter participation. The Harvest Information Program currently being implemented by the FWS and state wildlife agencies is, in part, designed to address the problems with these, and other migratory bird surveys. Within the next several years, the Harvest Information Program will provide estimates of the total woodcock harvest, more comprehensive information on hunter effort and success, and larger samples of wings where needed.

Singing-ground Survey

There were no detectable ($P > 0.1$) changes in the number of woodcock heard displaying during the Singing-ground Survey in 1999 in the Eastern Region, although the survey suggested an increase of 3.5%. Apparent trends were positive in some states and provinces and negative in others. In the Central Region, the number of woodcock heard displaying decreased 13.4% ($P < 0.01$); apparent trends were positive in some states and provinces and negative in others. Significant declines ($P < 0.05$) were observed in Michigan and Ohio (27.6 and 36.1%,

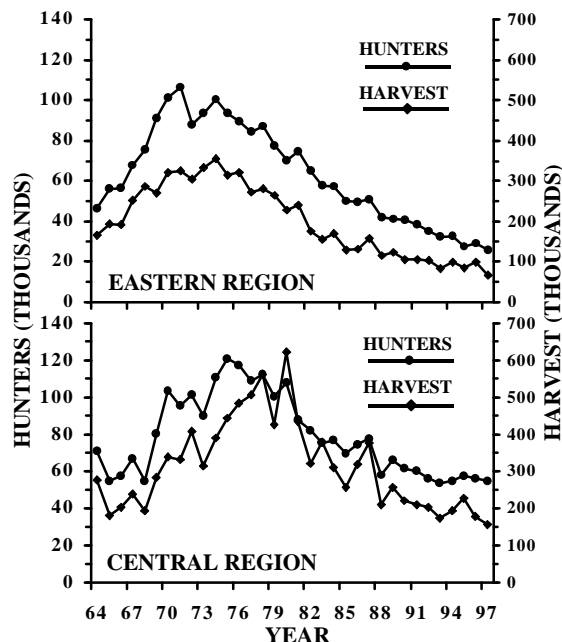


Fig. 8. U. S. harvest of American woodcock by duck stamp purchasers, and hunter numbers, 1964-97 (Martin 1979, and unpubl. rep., FWS, Office of Migratory Bird Management, Laurel, Maryland).

respectively). Intermediate (1989-99) and long-term (1968-99) trends in the number of displaying woodcock remained negative. The major causes of these declines are thought to be degradation and loss of suitable habitat on both the breeding and wintering grounds, resulting from forest succession and various human uses (Dwyer et al. 1983, Owen et al. 1977, Straw et al. 1994). If current trends in land use practices persist, continued long-term population declines are likely.

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Table 1. Distribution of hunters contacted and hunters who submitted woodcock wings in the 1998-99 Wing-collection Survey.

State of residence	No. of hunters Contacted	No. of hunters who submitted wings	Percent who submitted wings
AL	14		
AR	12		
CT	115	1	1
DE	13		
FL	57		
GA	59	5	8
IL	77	5	6
IN	62	13	21
IA	33	2	6
KS	8		
KY	23	4	17
LA	126	26	21
ME	164	19	12
MD	59	8	14
MA	214	7	3
MI	532	313	59
MN	306	107	35
MS	9	1	11
MO	75	17	23
NE	16		
NH	97	11	11
NJ	78	7	9
NY	270	23	9
NC	60	6	10
ND	6		
OH	93	25	27
OK	22		
PA	286	64	22
RI	24	4	17
SC	42	2	5
TN	53	4	8
TX	51		
VT	91	12	13
VA	78	8	10
WV	19	5	26
WI	507	231	46
Total	3,751	930	25

Table 2. Numbers of woodcock wings received from hunters, and indices of recruitment. Recruitment indices for individual states were calculated as the ratio of immatures per adult female. The regional indices for 1998 were calculated as the average of the state values, adjusted for comparability with the 1963-97 average. Recruitment indices were not calculated for states where the sample of wings was <125.

State or Region of harvest	Wings received							
	Total		Adult females		Immatures		Recruitment index	
	1963-97	1998	1963-97	1998	1963-97	1998	1963-97	1998
Eastern Region								
CT	12,914	3	2,866	1	7,913	2	2.8	
DE	410	0	54	0	287	0	5.3	
FL	660	0	150	0	410	0	2.7	
GA	2,884	18	887	5	1,253	9	1.4	
ME	70,269	137	20,646	36	35,225	75	1.7	2.1
MD	3,710	29	923	7	2,083	17	2.3	
MA	18,362	28	5,507	8	9,191	12	1.7	
NH	25,431	126	8,237	34	11,756	66	1.4	1.9
NJ	23,905	22	5,529	9	14,100	10	2.6	
NY	48,975	171	16,093	62	22,939	81	1.4	1.3
NC	2,789	36	809	10	1,397	18	1.7	
PA	26,180	274	8,183	97	12,253	119	1.5	1.2
RI	2,208	7	413	1	1,495	5	3.6	
SC	2,070	33	624	5	1,016	14	1.6	
VT	18,717	80	5,959	19	8,817	45	1.5	
VA	3,406	89	774	29	2,047	37	2.6	
WV	4,992	38	1,517	12	2,536	20	1.7	
Region	267,882	1,091	79,171	335	134,718	530	1.7	1.7
Central Region								
AL	910	0	243	0	425	0	1.7	
AR	510	0	163	0	207	0	1.3	
IL	1,201	22	271	2	688	13	2.5	
IN	6,398	73	1,572	20	3,622	40	2.3	
IA	859	3	294	0	377	3	1.3	
KS	44	0	9	0	22	0		
KY	904	21	213	7	476	6	2.2	
LA	27,708	300	6,193	66	18,024	194	2.9	2.9
MI	89,910	3,202	28,861	1,010	45,469	1,589	1.6	1.6
MN	25,223	922	8,481	307	11,560	379	1.4	1.2
MS	1,680	36	478	8	859	16	1.8	
MO	2,488	89	600	26	1,263	39	2.1	
NE	10	0	4	0	5	0		
OH	12,800	153	3,864	43	6,122	66	1.6	1.5
OK	161	0	37	0	84	0	2.3	
TN	898	57	218	15	460	32	2.1	
TX	945	0	239	0	488	0	2.0	
WI	56,680	1,609	18,272	567	27,930	745	1.5	1.3
Region	229,329	6,487	70,012	2,071	118,081	3,122	1.7	1.6

Table 3. State and regional indices of daily and seasonal woodcock hunting success in 1997 and 1998. State and regional indices were calculated for states represented by ≥ 10 hunters who participated in the Wing-collection Survey both years. Regional indices were weighted as described by Clark (1970).

State of harvest	No. of successful hunters	No. of successful hunts		Woodcock bagged		Woodcock per successful hunt		Woodcock per season	
		1997	1998	1997	1998	1997	1998	1997	1998
Eastern Region									
CT	1	1	1	1	3				
GA	2	5	6	12	8				
ME	15	66	54	123	106	1.9	2.0	8.2	7.1
MD	3	7	6	9	12				
MA	4	14	7	22	14				
NH	9	50	53	90	103				
NJ	4	12	8	27	12				
NY	15	55	57	90	110	1.6	1.9	6.0	7.3
NC	3	11	16	16	31				
PA	41	128	116	247	215	1.9	1.9	6.0	5.2
RI	2	5	3	9	4				
SC	2	14	15	23	33				
VT	7	28	30	48	58				
VA	5	25	31	49	78				
WV	4	15	17	32	36				
Region	117	436	420	798	823	1.8	1.9	6.9	6.6
Central Region									
IL	1	8	6	17	14				
IN	9	30	32	59	55				
IA	2	9	2	19	3				
KY	1	5	5	6	11				
LA	19	103	105	282	269	2.7	2.6	14.8	14.2
MI	227	1,178	1,313	2,345	2,763	2.0	2.1	10.3	12.2
MN	63	269	318	529	669	2.0	2.1	8.4	10.6
MS	1	10	12	30	36				
MO	13	32	36	63	67	2.0	1.9	4.8	5.2
OH	12	67	61	177	118	2.6	1.9	14.8	9.8
TN	2	10	12	19	32				
WI	124	472	546	965	1,116	2.0	2.0	7.8	9.0
Region	474	2,193	2,448	4,511	5,153	2.1	2.1	10.0	11.0

Table 4. Trends (% change per year^a) in the number of American woodcock heard in the Singing-ground Survey as determined by the estimating equations technique (Link and Sauer 1994).

State, Province or Region	No. of Routes ^b	1998-99			1989-99			1968-99		
		<i>n</i> ^c	% change	90% CI	<i>n</i> ^c	% change	90% CI	<i>n</i> ^c	% change	90% CI
CT	2				3	5.0	-2.3 12.3	9	-9.4 **	-15.9 -2.9
DE	2	2	-77.4 ***	-106.2 -48.7	2	15.0	-5.8 35.8	2	6.6	-12.0 25.2
ME	43	24	6.6	-12.6 25.7	55	-3.9 ***	-5.4 -2.3	63	-2.4 ***	-3.4 -1.4
MD	7				8	-10.2	-51.1 30.7	21	-16.5 ***	-26.7 -6.4
MA	13	6	107.7 **	17.6 197.9	15	4.1	-2.1 10.4	20	-5.1 **	-8.7 -1.5
NB	43	22	12.1	-7.0 31.3	52	-1.8	-4.3 0.7	62	-1.4 **	-2.4 -0.3
NH	10	5	4.0	-27.6 35.6	10	5.9 ***	2.7 9.2	17	0.2	-2.9 3.2
NJ	2				7	-24.7 **	-42.3 -7.2	17	-11.7 ***	-15.8 -7.5
NY	64	36	-1.9	-18.3 14.6	71	-4.6 ***	-6.9 -2.3	104	-2.6 ***	-3.6 -1.5
NS	35	25	23.5	-13.3 60.2	38	2.8	-1.3 6.9	55	-1.1	-2.2 0.1
PA	29	14	-19.3	-44.0 5.4	26	1.2	-3.8 6.2	55	-5.0 ***	-7.3 -2.6
PEI	6	4	-19.9	-82.9 43.1	9	-7.1	-17.0 2.8	12	-0.8	-2.4 0.9
QUE	27	6	12.9	-15.6 41.5	13	-8.7 **	-15.2 -2.1	54	0.6	-1.0 2.3
RI								2	-17.1 ***	-24.9 -9.2
VT	16	12	7.7	-28.5 43.9	18	-2.4	-8.4 3.6	21	-2.5 ***	-4.1 -1.0
VA	19	4	104.9	-332.0 541.8	12	-9.6	-21.1 1.8	44	-10.3 ***	-14.4 -6.3
WV	20	6	55.2	-54.7 165.1	17	-3.3	-9.8 3.3	42	-2.2 *	-4.3 -0.1
Eastern	338	167	3.5	-5.0 12.0	356	-3.3 ***	-4.5 -2.1	600	-2.4 ***	-2.9 -1.9
IL	3				11	9.3	-4.1 22.7	23	17.1	-16.1 50.3
IN	16	5	-17.4	-65.1 30.4	8	-3.1	-9.8 3.6	38	-5.7	-12.2 0.8
MB ^e	23	7	26.7	-19.6 72.9	15	-4.1	-9.1 0.9	15	-4.1	-9.6 1.4
MI	92	46	-27.6 ***	-38.6 -16.6	122	-2.9 ***	-4.4 -1.5	140	-1.4 ***	-2.0 -0.8
MN	67	37	2.7	-10.3 15.8	75	-4.0 ***	-5.7 -2.4	97	-1.2 **	-2.1 -0.3
OH	27	12	-36.1 **	-61.1 -11.2	30	-4.2	-10.8 2.3	53	-5.7 **	-9.9 -1.5
ON	47	15	-16.2	-37.1 4.6	108	-4.1 ***	-5.6 -2.6	135	-1.4 ***	-2.1 -0.7
WI	69	34	5.5	-14.0 24.9	75	-5.3 ***	-7.1 -3.5	98	-1.9 ***	-2.7 -1.2
Central	344	156	-13.4 ***	-20.7 -6.1	444	-3.7 ***	-4.5 -2.9	599	-1.6 ***	-2.0 -1.3
Continent	682	323	-8.0 **	-13.7 -2.3	800	-3.6 ***	-4.3 -3.0	1199	-1.9 ***	-2.2 -1.6

^a Mean of weighted route trends within each state, province or region. To estimate the total percent change over several years, use: $(100((\% \text{ change}/100)+1)^y)-100$ where *y* is the number of years. Note: extrapolating the estimated trend statistic (% change per year) over time (e.g., 30 years) may exaggerate the total change over the period.

^b Total number of routes surveyed in 1999 for which data were received by 1 June.

^c Number of comparable routes with at least 2 non-zero counts.

^d Indicates slope is significantly different from zero: * $P < 0.10$, ** $P < 0.05$, *** $P < 0.01$; significance levels are approximate for states where *n* < 10.

^e Manitoba began participating in the Singing-ground Survey in 1990.

Table 5. Breeding population indices for American woodcock from the Singing-ground Survey, 1968-99. These indices are based on the 1968-99 trend and should be used for exploratory data analysis only; observed patterns should be verified using trend estimation methods (Sauer and Geissler 1990).

State, Province or Region	Year														
	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Eastern Region															
CT ^a	-- ^b	5.75	5.76	4.50	5.55	4.12	4.06	4.32	2.37	2.78	1.68	1.70	1.49	2.01	2.56
DE ^a	0.34	0.28	0.34	0.25	0.34	0.57	0.51	1.14	0.37	0.50	0.50	0.43	--	--	--
ME	5.04	5.21	5.47	4.96	4.67	4.97	4.93	5.26	4.66	4.19	3.85	4.20	3.70	4.04	2.79
MD	16.17	13.70	11.95	10.50	8.40	9.40	5.27	5.35	3.60	3.13	3.22	2.39	2.85	2.46	2.33
MA	--	3.93	4.60	5.37	3.93	5.25	4.23	2.44	3.21	2.43	2.82	3.09	2.22	2.23	1.90
NB	--	5.54	5.80	5.59	5.80	5.12	5.65	6.38	4.67	5.77	4.12	4.55	4.03	4.05	4.20
NH	--	3.10	3.58	2.90	3.63	2.82	3.86	3.27	4.03	3.36	3.32	3.40	4.12	4.30	2.52
NJ	8.50	7.23	8.89	11.08	6.49	9.09	8.89	6.55	3.62	3.99	2.36	4.07	2.53	1.94	1.87
NY	4.73	5.22	4.01	4.54	4.25	4.30	4.53	3.80	3.81	3.93	3.08	3.48	4.02	3.67	2.97
NS	4.12	2.93	2.51	3.07	2.94	2.82	3.49	3.00	2.60	2.59	2.95	2.42	2.27	2.09	1.86
PA	3.65	3.34	3.67	3.19	2.82	3.04	2.19	2.45	2.37	2.35	1.87	2.12	1.94	1.91	1.54
PEI ^a	--	3.34	2.57	4.78	2.84	2.28	3.06	4.67	3.98	3.51	2.81	3.47	2.58	1.96	2.11
QUE ^a	--	--	--	3.60	3.32	2.58	3.18	3.23	2.26	2.53	3.13	3.21	3.56	2.81	2.77
RI ^a	--	2.41	2.43	4.52	3.35	3.35	2.50	1.93	1.93	--	0.64	1.12	1.12	0.64	2.63
VT	--	2.86	4.84	3.61	4.06	3.58	3.45	3.93	3.55	4.22	3.19	3.04	2.68	2.38	1.76
VA	--	4.34	4.50	3.59	3.13	2.26	3.31	2.83	2.36	2.28	1.72	1.90	1.61	1.60	1.51
WV	1.49	1.68	1.20	1.17	1.42	1.15	1.11	1.28	1.12	1.14	0.78	1.15	0.95	1.31	1.16
Region	3.79	3.67	3.58	3.50	3.35	3.11	3.29	3.24	2.79	2.90	2.52	2.78	2.65	2.62	2.33
Central Region															
IL	--	--	0.05	0.06	0.07	0.08	0.07	0.14	0.11	0.13	0.13	0.16	0.17	0.25	0.19
IN	1.94	1.68	1.59	1.24	1.50	1.55	1.15	1.12	1.12	1.12	0.99	1.25	0.92	0.96	0.70
MB	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MI	5.77	5.65	5.39	5.20	4.94	5.09	5.92	5.96	5.50	5.04	5.34	5.27	5.20	4.35	4.60
MN	--	4.57	3.90	4.18	3.55	4.04	4.69	4.09	4.11	4.07	4.08	4.03	4.48	4.10	3.70
OH	--	--	3.07	3.12	2.62	2.17	2.80	2.12	2.31	2.64	2.11	1.64	1.63	1.87	1.36
ON	6.03	6.61	6.28	5.98	6.64	5.93	6.37	5.61	5.40	5.88	6.37	6.13	6.29	5.84	4.43
WI	4.18	4.13	4.46	3.94	3.75	3.83	3.92	3.79	3.63	3.94	4.10	3.99	3.44	2.94	2.87
Region	3.72	3.71	3.62	3.48	3.43	3.36	3.49	3.45	3.28	3.36	3.33	3.28	3.11	3.05	2.56
Continent	3.70	3.65	3.55	3.45	3.35	3.20	3.36	3.31	3.01	3.10	2.88	3.01	2.86	2.82	2.44

^a Annual indices are unreliable due to small sample size.

^b Insufficient data.

Table 5. Continued.

State, Province or Region	Year																
	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Eastern Region																	
CT ^a	1.97	1.36	1.18	1.71	0.81	2.01	0.85	0.76	0.81	0.55	0.45	0.57	0.76	0.70	0.61	0.59	1.65
DE ^a	1.68	0.93	1.01	-- ^b	--	--	--	2.60	1.17	0.87	--	--	--	2.59	2.59	5.12	1.50
ME	3.58	3.56	3.61	3.75	4.09	3.85	3.98	2.72	3.40	2.88	3.09	2.71	2.93	2.19	2.52	2.32	2.96
MD	1.43	1.02	1.01	0.86	0.58	0.64	0.72	0.53	0.46	0.16	0.29	0.32	0.17	0.21	0.21	0.13	0.13
MA	1.40	2.46	1.92	1.96	2.05	2.03	1.58	1.44	1.72	1.42	1.19	1.34	0.99	1.25	1.33	1.23	1.95
NB	4.43	3.55	3.69	3.23	3.82	4.06	5.27	4.16	3.95	3.79	5.06	5.01	4.19	3.47	4.37	3.59	4.77
NH	2.95	2.62	2.78	4.71	3.35	3.36	3.45	2.97	4.03	2.34	2.88	2.52	4.68	3.78	4.10	3.74	4.01
NJ	2.15	2.42	1.74	1.66	1.88	1.44	1.32	0.89	0.79	0.63	0.62	0.29	0.67	0.59	0.16	0.51	0.45
NY	3.44	2.76	3.51	2.98	2.74	3.18	2.47	2.96	3.22	2.73	2.24	2.24	2.38	2.18	2.19	2.24	2.21
NS	2.32	2.23	2.22	2.61	2.33	2.52	2.72	1.88	2.22	2.48	2.65	2.07	2.51	2.50	1.96	2.19	2.39
PA	1.75	1.84	1.42	1.64	1.54	1.53	1.13	1.42	1.60	1.15	1.33	0.64	1.23	0.99	0.96	0.95	0.79
PEI ^a	3.34	3.79	2.80	3.68	2.58	4.11	3.95	3.23	2.42	2.40	2.31	2.37	2.75	3.13	2.72	2.87	2.53
QUE ^a	3.47	2.87	3.56	3.44	3.63	3.18	3.99	3.17	3.80	3.39	4.05	3.14	3.82	1.40	2.70	2.90	3.67
RI ^a	1.88	1.58	0.53	0.53	--	0.79	0.79	--	0.12	--	--	--	--	--	0.04	--	--
VT	2.57	2.54	2.00	2.52	2.68	3.18	2.92	2.77	2.72	1.75	1.82	1.84	2.09	1.57	2.02	2.29	2.14
VA	1.19	1.72	0.87	0.89	0.92	0.66	0.62	0.58	0.57	0.47	0.51	0.42	0.34	0.30	0.36	0.27	0.26
WV	1.22	1.00	0.95	0.91	1.05	0.83	0.87	0.92	0.85	0.84	0.76	0.64	1.14	0.73	0.80	0.67	0.71
Region	2.58	2.45	2.34	2.38	2.41	2.34	2.28	2.10	2.30	1.97	2.07	1.72	2.10	1.58	1.78	1.74	1.89
Central Region																	
IL	0.29	0.30	0.52	0.42	0.60	0.56	0.65	0.53	0.81	0.93	1.14	1.10	1.04	2.57	1.15	--	1.51
IN	0.74	0.73	0.60	0.81	0.59	0.58	0.56	0.64	0.67	0.59	0.55	0.50	0.53	0.42	0.34	0.69	0.45
MB	--	--	--	--	--	--	--	--	--	2.34	4.16	2.24	2.44	2.31	1.28	1.63	1.81
MI	4.01	4.42	4.63	4.72	4.36	4.73	4.55	4.45	5.25	3.75	3.76	3.44	3.73	3.53	3.44	4.09	3.31
MN	3.36	2.99	3.57	3.75	3.58	4.00	3.53	4.00	3.75	3.15	3.37	2.97	3.31	2.99	2.53	3.17	3.17
OH	1.73	1.60	1.39	1.09	1.19	1.44	0.99	1.37	1.04	0.93	0.97	0.81	0.81	0.85	0.66	0.70	0.59
ON	4.59	4.83	4.93	4.91	5.12	5.05	5.39	5.07	5.03	4.85	4.39	3.83	4.82	3.54	4.10	4.16	4.12
WI	2.89	3.16	2.92	3.42	3.40	3.41	3.15	3.08	3.09	2.46	2.44	2.30	2.29	2.41	2.30	2.21	2.55
Region	2.77	2.68	2.87	2.87	2.88	2.88	2.74	2.76	2.89	2.45	2.61	2.26	2.41	2.43	1.95	2.36	2.21
Continent	2.68	2.57	2.60	2.63	2.65	2.61	2.52	2.43	2.61	2.23	2.36	2.00	2.28	2.00	1.89	2.06	2.08

^a Annual indices are unreliable due to small sample size.^b Insufficient data.